Unit 14 · Plane Figures

HARDER PRACTICE QUESTIONS · ANSWER KEY

Full marks 35

Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Spot the errors

ANSWER U · 4

i. **It can't.** $3 + 4 = 7$ is less than 8: the two arcs never meet.
ii. **29 cm.** $20^2 + 21^2 = 400 + 441 = 841 = 29^2$. He added the sides without squaring.
iii. They bisect each other, but cross at right angles **only in a square**.
iv. **It can't.** $70° + 115° = 185°$, more than 180°: the two arms move apart and never meet.

MARKING SCHEME

✓ i. No triangle: $3 + 4$ is less than 8.
✓ ii. 29 cm.
✓ iii. At right angles only in a square.
✓ iv. No triangle: the angles make more than 180°.

2 One, many or none?

ANSWER U · 4

a. **One**: two sides and the angle between them (SAS) fix a triangle.
b. **Many**: three angles fix only the shape, so the triangle can be any size.
c. **None**: $4 + 5 = 9$ is less than 10.
d. **One**: $\angle Y = 180° - 40° - 75° = 65°$, so this is a side and the two angles on it (ASA).

MARKING SCHEME

✓ a. One: SAS.
✓ b. Many: only the shape is fixed.
✓ c. None: $4 + 5$ is less than 10.
✓ d. One: find $\angle Y = 65°$, then ASA.

3 A triangle with a 105° corner

ANSWER A · 4

i. Draw $AB = 5$ cm. At A, construct 105° (bisect between 90° and 120°); at B, on the same side, construct 45° (bisect 90°). The arms meet at C.
ii. $180° - 105° - 45° = \mathbf{30}°$.
iii. $BC \approx$ **9.7 cm** and $AC \approx$ **7.1 cm** (within a millimeter or two).
iv. BC, opposite the biggest angle, $\angle A =$ **105**°. The shortest side, AB, is opposite the smallest angle, $\angle C = 30°$.

MARKING SCHEME

✓ i. The construction, with arcs.
✓ ii. 30°.
✓ iii. About 9.7 cm and 7.1 cm.
✓ iv. BC, opposite the 105° angle.

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4 Build a parallelogram

ANSWER A · 4

i. Draw $PQ = 5$ cm, construct $60°$ at P and mark S 3.5 cm along that arm. Opposite sides are equal, so draw an arc of 5 cm from S and an arc of 3.5 cm from Q: they cross at R.

ii. Opposite angles are equal: $\angle R = \mathbf{60}°$; two angles next to each other add up to 180°: $\angle Q = \angle S = \mathbf{120}°$.

iii. $PR \approx 7.4$ cm and $QS \approx 4.4$ cm: **not equal**, since this parallelogram is not a rectangle.

iv. $PO = OR \approx 3.7$ cm and $QO = OS \approx 2.2$ cm: **the diagonals bisect each other**.

MARKING SCHEME

- ✓ i. The construction, R by two arcs.
- ✓ ii. 120°, 60°, 120°.
- ✓ iii. About 7.4 cm and 4.4 cm, not equal.
- ✓ iv. Each diagonal is cut in half.

5 The ladder

ANSWER A · 4

i. The ladder is the hypotenuse: $p^2 = 5^2 - 1.4^2 = 25 - 1.96 = 23.04$, so $p = \mathbf{4.8\ m}$ ($4.8 \times 4.8 = 23.04$).

ii. $p^2 = 25 - 9 = 16$, so $p = \mathbf{4\ m}$.

iii. $4.8 - 4 = \mathbf{0.8\ m}$.

iv. **No**: the top slid down only 0.8 m. The sides don't change by equal amounts, because their **squares** must keep adding up to 25.

MARKING SCHEME

- ✓ i. 4.8 m.
- ✓ ii. 4 m.
- ✓ iii. 0.8 m.
- ✓ iv. No: 0.8 m, not 1.6 m.

6 Short cuts

ANSWER A · 4

i. $h^2 = 80^2 + 60^2 = 6400 + 3600 = 10000$, so $h = \mathbf{100\ m}$.

ii. $80 + 60 = 140$ m, so the diagonal is **40 m shorter**.

iii. The longest straight line across the doorway is its diagonal: $\sqrt{2^2 + 1.5^2} = \sqrt{4 + 2.25} = \sqrt{6.25} = 2.5$ m. **Yes**: tilted along the diagonal, 2.4 m fits.

iv. $\sqrt{225 + 64} = \sqrt{289} = \mathbf{17\ cm}$.

MARKING SCHEME

- ✓ i. 100 m.
- ✓ ii. 40 m shorter.
- ✓ iii. Yes: the diagonal is 2.5 m.
- ✓ iv. 17 cm.

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7 Name it from its diagonals

ANSWER U · 4

a. A **rectangle** that is not a square: a parallelogram with equal diagonals is a rectangle.
b. A **square**: equal diagonals that cross at right angles.
c. A parallelogram that is **not a rectangle** (so not a square either).
d. A **rectangle**: the angle next to it is $180° - 90° = 90°$, and opposite angles are equal, so all four are 90°.

MARKING SCHEME

✓ a. A rectangle.
✓ b. A square.
✓ c. Not a rectangle or a square.
✓ d. A rectangle: all four angles are then 90°.

8 Think: right triangles with whole sides

ANSWER HA · 4

i. $7^2 + 24^2 = 49 + 576 = 625 = 25^2$ ✓.
ii. The two bigger numbers are **next to each other** (4 and 5, 12 and 13, 24 and 25), and they **add up to the square of the smallest**: $4 + 5 = 9 = 3^2$, $12 + 13 = 25 = 5^2$, $24 + 25 = 49 = 7^2$.
iii. They add up to $9^2 = 81$ and are next to each other: **9, 40, 41**.
iv. $9^2 + 40^2 = 81 + 1600 = 1681 = 41^2$ ✓.

MARKING SCHEME

✓ i. $49 + 576 = 625$.
✓ ii. Next to each other, adding up to the square of the smallest.
✓ iii. 9, 40, 41.
✓ iv. $81 + 1{,}600 = 1{,}681$.

9 Make your own

ANSWER A · 3

For example:

i. 2 cm, 3 cm and 6 cm (no triangle); 5 cm, 5 cm and 4 cm (isosceles).
ii. 8, 15, 17 ($64 + 225 = 289$), or 12, 35, 37 ($144 + 1225 = 1369$), or one from Think.
iii. The diagonals bisect each other, so each side is the hypotenuse of a right triangle with sides 3 cm and 4 cm: **5 cm**, all four.

Any correct answers are right in i and ii.

MARKING SCHEME

✓ i. Lengths that fail and lengths that work.
✓ ii. A whole-number right triangle.
✓ iii. 5 cm each.

See it at Science Playground

Exhibits and plants at the center, Bhaktapur, that go with this unit. Book a class visit at science-playground.com/booking.

- **Tangram Puzzle** (exhibit): Check the parallelogram piece: its opposite sides are equal, its opposite angles are equal, 45° and 135°, and any two neighboring angles add up to 180°.
- **Pythagoras in Beads** (exhibit): Find the hypotenuse, opposite the right angle. Tilt the frame: the beads from its square pour into the two smaller squares and fill them exactly, $h^2 = p^2 + b^2$.
- **Pythagoras in Squares** (exhibit): Read the Pythagorean triples on its base and check one: for 5, 12 and 13, $5^2 + 12^2 = 25 + 144 = 169 = 13^2$.
- **Pythagoras in the Garden** (exhibit): Find the right angle where the red and blue frames meet. The yellow square stands on the side opposite it: the hypotenuse, the longest side.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	0	12	19	4	**35**

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